REMARKS/ARGUMENTS

Applicant responds herein to the Office Action dated October 5, 2004.

Claims 1-17, 19-35 and 37 stand rejected on grounds of anticipation by Basceri (6,753,618). The remaining claims 18 and 36 are asserted to be obvious over Basceri, in view of Roberts (6,461,914). Reconsideration is requested.

In the instant application, a semiconductor device manufacturing method entails a first stage and a second stage. As characterized, for example, in independent claim 1, the first stage involves introducing a material gas containing a desired metal into a reaction chamber for the purpose of forming an oxide film made of the specified metal by a vapor-phase growth method.

The second stage involves removing the material gas introduced into the reaction chamber at the first stage "and a byproduct produced at said first stage", from the reaction chamber. Thus, the first stage adds and the second stage removes. By repeating the two stages several times, layers of the desired metal are deposited on a surface of a semiconductor substrate.

The instant invention is generally directed toward the objective of avoiding the drawbacks that result in undesirable filling with the byproduct of the first stage deposition, as generally described at page 5 to page 6, line 22 of the instant application.

Respectfully, the primary Basceri reference does not disclose the two stage manufacturing steps, as summarized above. In paragraph 3 of the Office Action, the Examiner is referring the applicant to column 11, lines 5-7 of this reference, and further mentions that this reference teaches "...and the following second stage for removing from said reaction chamber said material gas introduced into said reaction chamber at said first stage (remove the halogen, i.e., chloride) and a byproduct produced at said first stage...". Applicant's careful review of the assertions in paragraph 3 of the Office Action, reveals that column 11, lines 5-7 teach the deposition of two materials, rather than the deposition of one and removal of the other (the byproduct). The word "halogen" does not appear in this document. The term "chloride" is always mentioned in connection with the deposition of a material, rather than the removal thereof. Similarly, the word "byproduct" does not appear in the document being cited.

More specifically, Basceri discloses ALD processing in which **a first species of a precursor**, which may be a titanium source precursor containing chlorine (Cl), such as $TiCl_4$ (titanium tetrachloride) or $TiCl_3$ (titanium trichloride), for example, is first deposited over the initial surface of the $A_{12}O_3$ dielectric layer 80 (Fig. 14) **as a first self-terminating monolayer. A second species of precursor**, which may be an ammonia (NH_3) source, for example, is next applied over the monolayer of the first species of precursor. **The self-terminating monolayer of the second species of precursor reacts with the self-terminating monolayer of the first species of precursor to form a titanium nitride (TiN) layer**. Each of the TiN layers of the first and second species of precursors are provided on the surface of the $A_{12}O_3$ dielectric layer 80 by first pulsing the first species and then the second species into the region of the surface of the $A_{12}O_3$ dielectric layer 80. As explained above, **the sequence of depositing the monolayers of the first and second species of precursors can be repeated cycle after cycle** and as often as needed, until a desired thickness is reached for the titanium nitride (TiN) 90 (column 10, line 57 to column 11, line 8).

That is, with Basceri's ALD method, **introduction of the first and the second species of the precursors** into a reaction chamber are alternately repeated two or more times, and thus monolayers made up of a nitride or oxide are stacked every cycle, until a desired thickness is reached for a nitride or oxide film.

In contrast, the claimed invention has features of introducing a material gas (**a first species of precursor**) into a reaction chamber and **forming a metal oxide film** (a non-self-terminating multi-layer being thicker than a monolayer) on a semiconductor substrate with a metal film, by using a vapor-phase growth method at a first stage (step). The next step involves **removing a reaction byproduct produced from the first species of precursor at the first stage** (step), wherein the first step and the second step are alternately repeated two or more times, until a desired thickness is reached for the metal oxide film.

That is, with the claimed invention's method, **introduction of the first species of precursor** into a reaction chamber and removing of a byproduct produced from **the first species of precursor** are alternately repeated two or more times, until a desired thickness is reached for the metal oxide film, thereby being capable of suppressing explosive and abnormal growth of the

metal oxide film, which causes film to grow non-uniformly, due to the growth promoting action of the reaction byproduct.

This vapor-phase growth (CVD) method as claimed **excludes** entirely the formation in monolayer steps, that is, a form of atomic layer deposition (ALD), and is applied to the deposition of only a multilayer in each cycle.

Since the ALD method is set at a low deposition temperature for achieving a self-limited reaction, a material used as a precursor is liable to be limited. For example, it is difficult to apply a tantalum penta-ethoxide ($Ta(OC_2H_5)_5$; PET) to the ALD

For the reasons set forth, it is respectfully submitted that none of the independent claims in the application, which specifically recite a second stage removal step of a certain byproduct, and the repetition of the process, so that the layer grown in the first stage can be increased in thickness, is taught or even suggested in the references of record. The remaining claims in the application which are dependent from one or the other of the independent claims in the application include all their limitations and impose further limitations thereon, which places them even more apart from the prior art. As such, it is respectfully urged that all of the claims in the application clearly distinguish over the prior art of record.

Accordingly, the Examiner is respectfully requested to reconsider the application, allow the claims and pass this case to issue.

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on January 5, 2005

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Signature

January 5, 2005
Date of Signature

Respectfully submitted,

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